

THE AMERICAN MINERALOGIST

JOURNAL OF THE MINERALOGICAL SOCIETY OF AMERICA

Vol. 11.

JANUARY, 1926

No. 1

THE IDENTITY OF GILPINITE AND JOHANNITE*

ESPER S. LARSEN AND HARRY BERMAN, *Harvard University*

In 1917 Larsen and Brown¹ described a hydrous uranium sulfate with some copper, iron and soda, from Gilpin County, Colo., and Cornwall, England. The chemical analysis of this mineral was different from that of johannite and other described uranium minerals and the data on the optical and other physical properties of the latter minerals were almost entirely lacking, hence, the Colorado mineral was believed to be a new species and the name "gilpinite" was proposed for it.

At that time, no reliably labelled specimen of johannite could be found for optical data but recently a specimen labelled johannite from Joachimsthal that appeared to fit the original description was found in the Harvard Collection and a determination of the optical properties of this material showed so close a similarity with those of "gilpinite" as to leave no doubt as to the identity of the two. Crystallographic measurements on the Joachimsthal mineral and on the Colorado "gilpinite," though only fair, confirm the identification of the johannite, show its identity with "gilpinite" and establish the triclinic symmetry of the mineral.

The name johannite has the priority and should be retained for the species but the chemical composition and physical properties given for "gilpinite" are much to be preferred and should be assigned to johannite.

The physical properties of the mineral from different localities are given in Table 1. All are greenish-yellow to canary yellow, and are strongly pleochroic with X=colorless, Y=very pale yellow, Z=pale greenish yellow or canary yellow. They have a hardness of about 2. All show polysynthetic twinning in two directions, resembling those of plagioclase. The formula assigned to johannite is $\text{CuO} \cdot 3\text{UO}_3 \cdot 3\text{SO}_3 \cdot 4\text{H}_2\text{O}$ but the analyses of the Colorado "gilpinite" agrees rather closely with the formula

* Seventh contribution to Mineralogy from the Department of Mineralogy and Petrography, Harvard University.

¹ Larsen, E. S., and Brown, G. V.: Gilpinite, a new Uranium Mineral from Colorado, *Am. Min.*, 2, 75-79 (1917).

$(\text{Cu,Fe,Na}_2)\text{O} \cdot \text{UO}_3 \cdot \text{SO}_3 \cdot 4\text{H}_2\text{O}$ and should be accepted for the species.

TABLE 1. THE OPTICAL PROPERTIES OF JOHANNITE

	1. "Gilpinite" Colorado	2. "Gilpinite" Colorado	3. "Gilpinite" Cornwall	4. Johannite Joachimsthal
Opt. Char.	+	—	+	—
$2V_{\text{Na}}$	near 90°	near 90°	near 90°	near 90°
Disp. of $2V$	$\rho < \nu$ Strong	$\rho > \nu$ Strong	$\rho < \nu$ Strong	$\rho > \nu$ Strong
α	1.577	1.575	1.575	1.572
β	1.597	1.594	1.592	1.595
γ	1.616	1.611	1.612	1.614
Habit	Laths (010)	Laths (010)	Laths (010)	stout crystal
Opt. Orient.	X near b	X near b	X near b	
	$Y \wedge \text{elong.} = 5\frac{1}{2}^\circ$	$Y \wedge \text{elong.} = 8^\circ$	$Y \wedge \text{elong.} = 5^\circ$	

The close agreement between the optical properties of johannite from different localities is noteworthy. Most of the secondary uranium minerals show a rather unusual uniformity in the optical properties of specimens from different localities, indicating rather definite chemical compositions with little solid solution. The minerals carnotite and tyuyamunite are striking exceptions to this, probably due to variable content in water. The optical properties of the uranium minerals are also characteristic and they commonly serve to quickly and accurately determine the minerals on a very minute amount of material. As yet the data on some of the species is incomplete and careful study should bring to light a number of new species.

CRYSTALLOGRAPHIC DATA

In the latest discussion² of the crystallography of johannite from the Joachimsthal, Ježek referred the mineral to the monoclinic system although it was admittedly triclinic in its optical character. In the monoclinic orientation the mineral was considered as

² B. Ježek: *Bull. Internat. de l'acad. des Sci. de Boheme*, No. 21 (1915).

elongated in the direction of the b -axis with the prismatic faces in the orthodome zone (Fig. 1). The optical properties of the mineral do not permit this orientation because the extinction is not parallel to this direction. If the mineral is considered triclinic and the orientation shown in Table 2 is used, the ambiguity is removed and the angular relations somewhat simplified. In the gnomonic projection (Fig. 2) the triclinic character of this new orientation is graphically illustrated.



Fig. 1. Johannite, Joachimsthal.

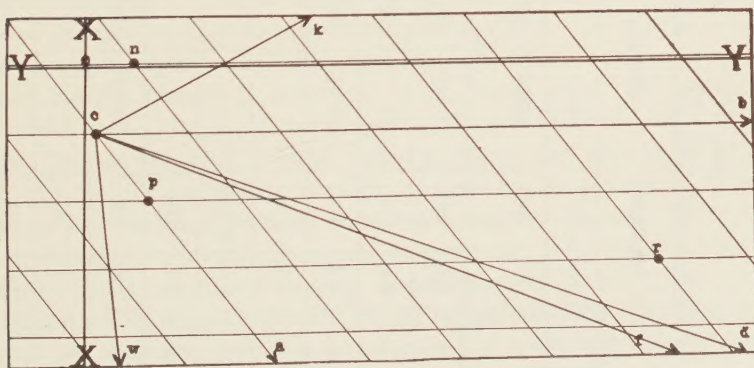


Fig. 2. Gnomonic projection of Johannite showing the forms:
 $c(001)$, $a(100)$, $b(010)$, $w(2\bar{1}0)$, $d(230)$, $f(10.13.0)$, $k(\bar{1}20)$, $p(101)$, $n(\bar{1}11)$, $r(251)$.

TABLE 2. ANGLE TABLE—JOHANNITE

$p_0 = .7075$ $a = 1.218$														$q_0 = .7750$ $c = .6736$														$\lambda = 86^{\circ}23'$ $\alpha = 69^{\circ}24'$														$\mu = 60^{\circ}59'$ $\beta = 124^{\circ}56'$														$\nu = 51^{\circ}17'$ $\gamma = 132^{\circ}56'$													
No.	Letter	Symbols			Measured		Calculated		Measured Ježek		Symbol Ježek	Letter Ježek	“Gilpinit”																																																								
		$p\ q$	$h\ k\ l$	ϕ	ρ	ϕ	ρ	ϕ	ρ	ϕ			ρ	ϕ	ρ																																																						
1	<i>c</i>	0	001	80°32'	35°17'	83°41'	35°07'	84°18'	33°46'	011	<i>x</i>	83°43' 82°31'	34°45' 40°14'																																																								
2	<i>a</i>	$\infty 0$	100	51°17'	90°00'	51°17'	90°00'	51°56'	90°00'	102	<i>e</i>	51°13'	90°00'																																																								
3	<i>b</i>	0 ∞	010	0	90°00'	0	90°00'	0	90°00'	100	<i>a</i>	0	90°00'																																																								
4	<i>k</i>	$\infty 2$	120	— 27°21'	90°00'	— 27°21'	90°00'	— 26°39'	90°00'	II.0.7	<i>k</i>																																																										
5	<i>d</i>	$\infty \frac{3}{2}$	230			18°59'	90°00'	19°54'	90°00'	201	<i>d</i>																																																										
6	<i>f</i>	$\infty \frac{13}{16}$	10.13.0			20°50'	90°00'	21°03'	90°00'	15.0.8	<i>f</i>																																																										
7	<i>w</i>	2 ∞	210			83°17'	90°00'	84°18'	90°00'	001	<i>c</i>																																																										
8	<i>p</i>	10	101	65°08'	56°32'	65°08'	56°32'	66°36'	57°22'	124	<i>p</i>																																																										
9	<i>n</i>	— 1	111			— 2°44'	25°51'	0	25°31'	120	<i>n</i>																																																										
10	<i>r</i>	25	251			19°09'	80°54'	19°54'	79°15'	10.2.5	<i>r</i>																																																										

The crystallographic measurements of johannite and "gilpinite" were made on crystals of the order of .5 mm in length. Only one of the three crystals measured had sufficient forms to permit the calculation of the axial ratios which was accomplished by the use of the forms c , a , b , k , and p , that is, by all of the forms observed on the measured crystal. These forms had each but one face represented on the crystal with the exception of b and a , which had two. The axial ratios obtained in this way fit rather closely the observed values of Ježek, whose angles were not used in the calculations. Table 2 shows the close agreement of the calculated angular values with those observed by him. The forms $d(230)$, $f(10.13.0)$, $w(2\bar{1}0)$, $n(\bar{1}11)$, $r(251)$, were not observed by the authors, the angles of these forms are therefore taken from Ježek's paper. The letters used to indicate the various forms are likewise taken from Ježek, with the exception of the three pinacoids c , a , and b , and the prism w .

In the last column of Table 2 are listed the observed angles for "gilpinite" which are seemingly sufficient to establish the crystallographic identity with johannite.

PURPLE MUSCOVITE FROM NEW MEXICO*

WALDEMAR T. SCHALLER AND EDWARD P. HENDERSON,
U. S. Geological Survey

Purple muscovite of various shades and presenting unusually attractive and striking color effects occurs abundantly in northern New Mexico as a constituent of pegmatite dikes. The purple color of the mica suggests lepidolite or some mica other than muscovite. The results obtained, however, have shown that this mica is normal muscovite in all its properties except that of color. The pleochroism is strong in basal cleavage pieces and, on comparison, it was found that other strongly colored micas are much more pleochroic in basal sections than commonly recognized. A brief examination, made for comparative purposes, of baddeckite from Nova Scotia, supposed to be a muscovite with considerable iron replacing the alumina, has led to the suggestion that the material analyzed and described was not a mica but a mixture of hematite and a clay.

* Published by permission of the Director of the U. S. Geological Survey.

The locality of the purple muscovite is in southwestern Taos County, New Mexico, in R. 11 E., T. 23 N., about sixteen miles SSW of the city of Taos and about thirty-seven miles east of north of Santa Fe, as measured in a straight line on the map, but in actual travel the distance is nearly twice as far. The purple muscovite is most abundant at the Harding mine which lies about nine and one half miles due east of Embudo as measured on the map and about thirteen miles as traveled. The mine is about half way between Picuris and Barranca. A deeper colored muscovite was collected from near the summit of the south bank of the Rio Grande River, about three miles NW of the Harding mine, and a mile or so SW of Pilar (Cieneguilla). This occurrence will be referred to as that of Pilar.

Samples of the muscovite from Pilar had been submitted for identification several years ago by Mr. James A. Burton of Embudo, New Mexico, and recently samples from the Harding mine were brought in by Mr. N. H. Darton of the U. S. Geological Survey.

In this region according to Mr. N. H. Darton, there is a pre-Cambrian complex from five to ten miles across, composed of schists, quartzites and probably other rocks. In this complex there are pegmatite dikes, ranging from less than a foot to probably more than a hundred feet in thickness. The Harding mine, locally known as the glass mine, is located on one of the large dikes which intrudes a dark colored schist containing much biotite and tourmaline. In this dike there were several large lenses of pure lepidolite, a mineral mined and shipped for use in the glass industry.

The dike also contains large quantities of spodumene, albite, and muscovite, as well as quartz and microcline. Apatite, garnet, columbite, and probably other minerals are present in smaller quantities. The albite, muscovite, and the lithium minerals have replaced the feldspar and quartz and there is a definite genetic relation in the dike between the different minerals. It is very evident that the purple muscovite has encroached upon, and more or less replaced, the other minerals so that these, too, take on some shade of purple, depending on the quantity of muscovite present. No tourmaline was found in the dike, neither was graphic granite encountered.

Purple, as a general term, describes the color of most of the specimens of muscovite although variations which range from

almost a pink through magenta to a deep violet are common. Many of the mica specimens are lilac in color, and on comparison a polished specimen of the mica is almost identical in shade and tint with a crystal of the lilac colored spodumene (kunzite) from southern California. It seemed best, however, to use the more general term purple which includes all the different shades involved.

A more accurate definition of the average color would be closely represented by Ridgway's "Eupatorium Purple" and "Daphne Pink," Plate XXXVIII. Smaller seams of the mica in white albite are perhaps better matched by Ridgway's "Rosolane Purple," Plate XXVI, especially the light and pale colors of the plate. A few specimens are almost a "Rosolane Pink." Where muscovite has replaced microcline, forming a compact fine-grained mass, darkened by black oxide of manganese, the specimens resemble the darker purples and violets of Plates XI and XXV. The muscovite from Pilar is much deeper colored than that from the Harding mine and carries the suggestion of a bronzy red or a coppery red color, agreeing with Ridgway's "Bordeaux," Plate XII, grading off into the adjacent colors. The streak (powder) of the mica from the Harding mine is white with a faint suggestion of a lilac tint, whereas that of the muscovite from Pilar is "Pale Vinaceous Lilac" (Ridgway), Plate XLIV. The streak of the muscovite from Pilar, compared to that from the Harding mine, shows a decided color.

The purple muscovite in the Harding mine is widely disseminated throughout the dike but at no place does it form large masses. No single mass of muscovite more than a foot thick was seen, though seams and aggregates several inches thick are abundant. The individual scales of the mica crystals range in size up to about half an inch across. They show no crystal boundaries, although many of the scales show a tendency toward the hexagonal form.

A more or less definite order of minerals can be observed in the walls of the open cuts of this mine. Massive white quartz which at places reaches a vertical thickness of about ten feet lies at the top. At many places where no mining has been done, large areas of the surface are covered with boulders of such quartz. It does not, however, extend universally over the pegmatite for at one place the quartz-feldspar pegmatite is in direct contact with the schist, with no massive quartz between. At this place seams and disseminated scales of lepidolite in the pegmatite extend to within a foot of the schist-pegmatite contact. But the absence of massive

quartz and the closeness to the pegmatite-schist contact of any lithium minerals are rare occurrences and in most places the cap of massive white quartz is characteristic.

Under this massive quartz is a zone of from ten to twenty feet in thickness of a mixture of white to gray massive quartz with numerous nearly vertical spodumene crystals which reach a length of ten feet, a width of one foot, and maximum thickness of not over one inch. Although the spodumene crystals are characteristically nearly vertical in the upper portion of this zone, many of them are irregularly oriented and in the lower portion they lie horizontally or inclined in various directions. Masses of darker colored quartz with smaller crystals of spodumene, oriented in various directions, are also present.

Below the spodumene zone is one characterized by an abundance of purple muscovite with white albite, white quartz, and yellowish or tawny colored crystals of spodumene, much smaller than those just described. If spodumene is absent, and the association is albite, quartz, and lepidolite, the lithium mica forms thin prismatic crystals, reaching a length of several inches and perhaps on the average about one twenty-fifth of an inch thick. These albite-quartz-lepidolite mixtures form curved masses, the mica prisms, slightly radiating, being approximately vertical. The strikingly colored aggregate of purple muscovite, yellowish spodumene, white albite and quartz, is remarkably free from any microcline as seen in the hand specimen, but a microscopic examination of thin sections of the finer grained compact muscovite shows residua of microcline full of minute shreds of the replacing mica. These compact masses of muscovite are generally of a darker shade than the coarser more granular mica.

In the western portion of the dike this muscovite-spodumene-albite-quartz aggregate is not well developed and its place seems to be taken by a microcline-spodumene mixture, both being slightly replaced and colored purplish by the incoming muscovite. The microcline especially is of an attractive purplish pink color, a most unusual shade for feldspar. Below this purplish microcline-spodumene mixture there seems to be another zone of muscovite-spodumene-albite-quartz but the exposures were insufficient to definitely establish this last relationship.

Below these strikingly colored mineral aggregates lies lepidolite, as small scales mixed with the other minerals and in greater

quantity when mixed with only albite or albite with a little quartz. Lepidolite becomes more abundant in a downward direction and the mixture of lepidolite and other minerals grades into a zone or set of lenses of nearly pure lepidolite, which is the material mined and shipped. It is reported that a zone of purplish microcline and spodumene, similar to the one mentioned above, was encountered below the zone of lepidolite lenses. Muscovite is practically absent in the zone where lepidolite is abundant. Though the lepidolite is purple, it generally has a more bluish tint than the muscovite and by this difference in color one mineral can readily be distinguished from the other.

The minerals in the pegmatite at the Harding mine—microcline, muscovite, spodumene, albite, quartz, and lepidolite, with smaller quantities of other minerals—are considered to be largely the product of a replacement process. In such a process, the muscovite has a definite position, coming in with the albite after the spodumene and before the lepidolite. Muscovite definitely replaces microcline and spodumene and probably also albite and quartz and together with these minerals is itself later probably replaced by lepidolite. In places it forms seams in the spodumene and the albite but it is especially prone to develop along their boundaries. A more detailed description of this dike and its minerals and genetic relations, is being prepared.

The deeper colored muscovite from near Pilar occurs disseminated through small quartz-microcline pegmatite dikes that cut the pink micaceous quartzite of the pre-Cambrian complex already mentioned. According to Mr. J. A. Burton, there are several dozen dikes containing the reddish purple mica and these dikes range in thickness up to several feet. One dike, from which the material examined was collected, is irregular in size and shape and from six inches to a foot in thickness. The dike is nearly vertical but inclines toward the west and cuts across the structure of the quartzite. The contact of the dike and quartzite as seen in the field was sharp and no difference could be seen in different parts of the dike except that the purple muscovite occurs concentrated in seams approximately parallel to the walls of the dike as well as scattered irregularly through it.

The dikes consist essentially of light gray microcline with smaller quantities of quartz and purple muscovite. A very little albite is seen in thin sections. Only a very small quantity of other

minerals was noted and only a few kaolinized areas were seen. Thin sections of the contact do not show a sharp boundary between the dike and the quartzite and suggest that the dike is not so much a separate igneous intrusion as probably a fissure replacement effect, together with coarser recrystallization and the introduction of enough material to develop considerable microcline. The fine grained muscovite scattered through the quartzite is very similar in color to that occurring in larger scales in the dikes. "Eyes" of quartz and of muscovite, very similar in appearance, are to be found in both rocks.

The scales of the reddish purple muscovite do not reach a large size. Masses an inch thick are found in the pegmatite but individual cleavage scales seldom exceed half an inch in width. It was thought that marked differences would be found in many of the properties of the purple mica from those of the common muscovite but the color and pleochroism show the only difference.

Both the Harding and Pilar muscovite are practically infusible before the blowpipe, with no flame coloration, when the standard test is applied. The purple color is lost, the scales becoming gray. Comparative tests with lepidolite scales of similar thickness showed a ready fusibility with the usual red flame coloration. In very thin cleavage plates, the purple muscovites slowly fuse to a grayish bead.

Examined optically, the Harding muscovite is colorless in thin sections and in thicker plates is very slightly pleochroic in shades of pink. The deeper colored mica from Pilar, however, is strikingly pleochroic, even in thin section, where basal plates are pink to yellowish. The optical orientation of the purple muscovites is normal, the axial plane being at right angles to $b(010)$, as determined by the position of the percussion figure.

The intensity of the pleochroism naturally varies with the thickness of the mineral. In thick cleavage scales, broken off with a knife point, the Harding muscovite is barely pleochroic in shades of pale pink; the Pilar muscovite is strongly pleochroic, from a pink or pale bluish purple (X), to brownish orange (Y), to a deep strawberry red (Z). This strong pleochroism on the basal cleavage plates is most striking and is fully as strong as the pleochroism on sections normal to the base. The absorption is $Z > Y > X$.

A strikingly strong pleochroism on basal cleavage flakes, while abnormal for ordinary muscovite, seems to be a not unusual feature

OPTICAL PROPERTIES OF PURPLE MUSCOVITE FROM NEW MEXICO

		Harding mine.	Pilar.	Normal muscovite.
Pleochroism in thin section	$\left\{ \begin{array}{l} X \\ Y \\ Z \end{array} \right.$	$\left. \begin{array}{l} \\ \\ \end{array} \right\}$ Almost none	$\left\{ \begin{array}{l} \text{Pale pink} \\ \text{Yellowish} \\ \text{Pink} \end{array} \right.$	$\left. \begin{array}{l} \\ \\ \end{array} \right\}$ None
Indices	$\left\{ \begin{array}{l} \alpha \\ \beta \\ \gamma \end{array} \right.$	$\left\{ \begin{array}{l} 1.558 \\ 1.587 \\ 1.591 \end{array} \right.$	$\left\{ \begin{array}{l} 1.565 \\ 1.597 \\ 1.602 \end{array} \right.$	$\left\{ \begin{array}{l} 1.561 \\ 1.590 \\ 1.594 \end{array} \right.$
2E		69° (Meas.)	77° (Meas.)	66°
Dispersion		$\rho > \nu$	$\rho > \nu$	$\rho > \nu$

For the determination of indices and axial angles, the writers are greatly indebted to Dr. Clarence S. Ross.

for muscovite which chemically contains a strongly chromatic oxide, replacing in part the colorless alumina of normally pure muscovite. The pleochroism of fuchsite, for example, is given as: X = pale greenish blue, Y = yellowish green, Z = dark bluish green. The deep green fuchsite from near Etchison, Maryland, is reported (Dana, System of Mineralogy, p. 617) to be strongly pleochroic with X = robin's egg blue, Y = yellowish green, Z = bluish chrome-green, which colors were verified on material collected from that locality.

The density of the muscovite from the Harding mine is 2.83 and that from Pilar somewhat richer in iron, is 2.85. These determinations were made in Thoulet solution.

The samples were broken from the rock matrix by using a dental pick and each small booklet of muscovite was then cleaved until both surfaces were clean and shiny. Several grams of material were prepared in this manner and then each piece was examined individually, first under a binocular and then under a microscope. The muscovite from the Harding mine was very easy to purify as the booklets were, generally speaking, free from any inclusions. Small straight cracks were present in some of the booklets of Pilar muscovite.

The analyses of the pure muscovite from New Mexico are shown below, with two analyses of pink muscovites (from Massachusetts and California) taken from the literature, and the figures for the calculated theoretical composition of pure muscovite.

In chemical composition there is very little variation in these micas from that of normal muscovite. Small quantities of iron and

ANALYSES OF PURPLE MUSCOVITE FROM NORTHERN NEW MEXICO.

[E. P. Henderson, analyst].

	Harding mine, N. M.	Pilar, N. M.	Goshen, ¹ Mass.	Mesa Grande ² Calif.	Theoretical
SiO ₂	44.80	45.16	47.02	45.63	45.2
Al ₂ O ₃	37.72	35.61	36.83	37.42	38.5
Fe ₂ O ₃	0.67	2.95	0.51	Trace	—
Mn ₂ O ₃	0.21	0.70	—	—	—
FeO	n.d.	None	—	—	—
MnO	—	—	1.05	0.06	—
MgO	None	None	0.26	—	—
K ₂ O	10.66	10.32	9.80	9.95	11.8
Na ₂ O	1.40	1.03	} 0.30	1.43	—
Li ₂ O	Trace	None		0.20	—
H ₂ O	4.52	4.36	3.90	4.43	4.5
F	0.20	0.05	0.52	0.77	—
	100.18	100.18	100.19	99.89	100.0
O. correction	.08	.02	.22	.32	
	100.10	100.16	99.97	99.57	

¹ Taken from Dana's System of Mineralogy, 6th ed., p. 618, analysis No. 8.² Taken from *U. S. Geol. Survey Bull.* 591, p. 330, analysis.

manganese are present as inherent parts of the mineral, probably replacing alumina, and their combined color effect produces the abnormal color and pleochroism of the mineral.

All the manganese is reported as Mn₂O₃. Caesium and rubidium were looked for but could not be detected by a small laboratory spectroscope. Lithium occurs in the Harding muscovite but it is estimated to be present only in spectroscopic traces and no quantitative determination was made. The ratio of Fe₂O₃ to Mn₂O₃ in the Harding mica is about 3:1 and in the Pilar mica about 4:1. The ratio of combined iron and manganese oxides in the two micas is about 1:4.

The ratios of the analyses give the normal muscovite formula, as is to be expected from a comparison of the analyses. For the Harding muscovite, the ratios of SiO₂:R₂O₃:Alk.₂O:H₂O are 5.91:2.98:1.08:2.04: and for the Pilar muscovite they are 6.03:2.99:1.02:1.96, which ratios are very close to 6:3:1:2.

For the Pilar mica, the ratio of $\text{Fe}_2\text{O}_3 + \text{Mn}_2\text{O}_3 : \text{Al}_2\text{O}_3$ is 1:15. Several analyses of muscovites with about this ratio of iron to alumina, and even with slightly more iron, are given by Kunitz.¹ The relationship he establishes for the densities of different muscovites according to their iron content is verified by the determinations of the micas from New Mexico. It was found, however, that the axial angle increases with an increase of iron content.

It is of considerable interest to see if there is any muscovite considerably richer in iron than those from New Mexico or those analyzed by Kunitz. A search of the literature revealed only one published description of a muscovite which seemed to have such a composition. This is the variety described in 1898 by Hoffmann² and named baddeckite. This mineral was found as minute scales in a plastic clay near Baddeck, Victoria County, Nova Scotia. Associated minerals are given as kaolinite (in crystalline scales), quartz, pyrite, and calcite. The copper-red baddeckite, according to Hoffmann, forms a highly plastic mass with water.

The density is given as 3.252, the fusibility as about 4.5 (to a shiny black slag), and the mineral is said to be decomposed by strong hydrochloric acid with the separation of slimy silica. The analysis was made upon "very carefully prepared and apparently perfectly pure material," though the means of purification are not stated.

A sample of baddeckite was received through the kindness of Professor T. L. Walker of Toronto. It has the properties and association ascribed to the original mineral and there seems to be no reason to question the identity of the material with the original baddeckite. The general appearance of the minute scales of the copper-red material at once suggests hematite, and such further examination of the material as was made, does not sustain the view that baddeckite is a muscovite, very high in ferric iron content.

Several attempts to separate in a pure state any of the red mineral from the clay gangue were unsuccessful. The minute scales, even in the concentrated layers, seem to have considerable clay admixed with them. Optical examination showed that the

¹ Kunitz, W., The relationships between the chemical composition and the physical-optical properties of the mica group: *Neues Jahrb. Min., etc.*, Beil. Band, **50**, pp. 365-413 (1924).

² Hoffmann, G. Chr., Annual Rep. Geol. Survey Canada (for 1896), Vol. **9**, p. 11R (1898), and (the same article) *Am. J. Sci.*, 4 ser., Vol. **6**, p. 274 (1898).

red mineral formed minute sharply bounded hexagonal plates of shades of red identical with the colors of thin hematite crystals of varying thickness.

The flat lying plates were nonpleochroic and isotropic and yielded a uniaxial interference figure, the sign of which could not be conclusively determined. The refractive index of the plates was much higher than 1.74. As the New Mexico muscovite, with a ferric iron content of nearly 3 per cent, is strongly pleochroic, it would be expected that a muscovite with 25 per cent of Fe_2O_3 would likewise be strongly pleochroic and show a marked differential absorption, as most high ferric iron silicates do. Moreover, a ferric iron silicate with so high a content of iron, would not be expected to be red but rather either black or green or some intermediate shade. A careful consideration of the properties of baddeckite therefore throws considerable doubt as to its being an iron rich mica.

As the general appearance of baddeckite and especially its optical properties suggest hematite and not an iron rich muscovite, it must be considered whether or not the chemical analysis given can be interpreted in such a way. The clay gangue is optically birefracting and has the general appearance and properties of those clay minerals which in late years have been classified as leverrierite. This clay matrix of the baddeckite carries a little quartz and numerous very fine rods of a yellowish mineral, probably rutile. A little calcite is present and pyrite has been reported.

A determination of the water content of the clay gangue, practically free from any baddeckite, as determined by loss on ignition, gave the following results (determinations made by W. T. Schaller):

LOSS OF CLAY GANGUE

Loss at 110°	=	0.97 per cent
Loss at 185°	=	0.58 per cent
Loss on ignition	=	<u>4.78</u> per cent
Total loss	=	6.33 per cent

These values of total loss are probably in excess of the true water content as they are not corrected for the losses caused by calcite and pyrite. The water content of the clay gangue, then, is close to the percentage of water given in the analysis of baddeckite.

This water content, especially that given off at a low temperature, is unusually small for any clay mineral. It is, however, very close to the water content, given off above 100° , by the minerals of the leverrierite group, as tabulated by Larsen and Wherry,³ these values for the percentages of H_2O+ ranging from 5.6 to 8.65 per cent. A sample of the clay gangue, kept in a desiccator over dilute sulphuric acid of density 1.105, for a week, increased only 3.46 per cent in weight and this was readily lost again by overnight exposure in the balance case. The analysis of baddeckite, as given, can be treated as showing the composition of a mixture of a clay mineral and hematite and if all the Fe_2O_3 reported be considered as such and the remainder of the analysis be reduced to 100 per cent, the figures obtained are not far from those reported for the clay mineral cimolite. The analysis of baddeckite is given below with its present interpretation, the remainder, after deducting the hematite, being recalculated to 100 per cent and compared with an analysis of cimolite.

ANALYSIS OF BADDECKITE INTERPRETED AS A MIXTURE
OF HEMATITE AND CIMOLITE

	Analysis.	Hematite.	Remainder re- calculated to 100 per cent.	Cimolite, Norway, Maine.
Fe_2O_3	25.82	25.82	—	—
SiO_2	48.96	—	66.07	66.86
Al_2O_3	13.85	—	18.69	22.23
CaO	1.17	—	1.58	^a 1.47
MgO	2.65	—	3.58	
K_2O	3.47	—	4.68	^b 0.99
Na_2O	0.22	—	0.30	—
H_2O	3.78	—	5.10	8.26
	99.92		100.00	99.81

^a Iron, manganese, lime, and magnesia.

^b Alkalies and 0.06 per cent fluorine.

The comparison is close enough to suggest the possible correctness of the interpretation. No information is given by Hoffmann as to the method used in his separation of the baddeckite from the

³ Larsen, E. S., and Wherry, E. T., Leverrierite from Colorado: *Jour. Wash. Acad. Sci.*, Vol. 7 (No. 8), p. 213 (1917).

clay gangue; if Thoulet solution was used, then the clay may well have extracted and retained potassium from the heavy solution.

Microscopic examination of baddeckite and brown micaceous hematite, placed side by side on a slide, showed no difference in appearance. Micaceous hematite scales, rubbed on the clay gangue, could not be told by appearance from baddeckite.

Although the conclusion that baddeckite is hematite and that the analysis was made on a mixture of hematite and a clay similar to cimolite, can not be considered to be definitely established, yet the evidence seems to be so suggestive that its possible correctness must be considered. In that case, there is no muscovite unusually rich in ferric iron, replacing the alumina, and the reddish purple muscovite from Pilar, New Mexico, must be placed with those muscovites having a maximum iron content.

MINERALOGY OF THE CHROME ORE FROM ETCHISON, MONTGOMERY CO., MD.

EARL V. SHANNON¹

An old chromite mine near Etchison in Maryland has been mentioned by Gill² as a locality for chrome tourmaline and fuchsite and the present writer has recently described a green margarite from this region.³ The mine now consists of a shallow depression surrounded by dumps, somewhat overgrown with briars. The only rock exposed in place is a mass of rusty talc in the pit. Beneath this talc outcrop is an old tunnel which still shows a narrow opening but, since no light was available, this was not explored.

The rocks on the dump are principally made up of a grayish, somewhat schistose material which is probably largely composed of talc and chlorite. One of the puzzling features encountered at the mine was the absence of anything which could be recognized as chromite, chrome ore being supposed to exist in large quantity here. Specimens were collected from what appeared to be an ore

¹ Published by permission of the Secretary of the Smithsonian Institution.

² A. C. Gill. Note on some minerals from the chrome pits of Montgomery County, Maryland. *Johns-Hopkins Univ. Circular*, Vol. 8, No. 75, pp. 100-101 (1889).

³ Earl V. Shannon. Chromium-colored margarite from Montgomery County, Maryland. *Amer. Mineralogist*, Vol. 9, pp. 194-195 (1924).

heap as the material most closely resembling chromite of any about the mine. It was decided that this material must be the ore or that every vestige of the chromite had been removed by the miners. This material forms the matrix of the margarite previously described and in that paper it was referred to as dark chocolate-colored serpentine. After two years of intermittent perusal of the collection from the Etchison mine, the writer finally concluded that this must be the ore of the mine. An examination of it was therefore undertaken to ascertain, if possible, what its mineralogical nature was and why it differed from ordinary chromite.

In ordinary hand specimens, as broken by the hammer, this material is dark brown or brownish black. The luster is hardly metallic and the impression gained, from handling it in chunks and specimens, is that the specific gravity is too low to be anything more than a silicate. There is a suggestion of cleavage or parting, probably octahedral in unit areas up to a centimeter broad, much interrupted by fractures filled with serpentine and margarite. The lump specific gravity as roughly determined on a piece from the analyzed sample, is 3.43, as compared with the range 4.32 to 4.57 given for chromite by Dana.

A polished surface of this material showed the base to be a single mineral, having, when polished, a very feeble suggestion of metallic luster and varying from medium dark brown to blackish-brown in color. This is enormously fractured, the fracturing amounting almost to complete crushing or grinding, and the cracks are filled with margarite and serpentine. The margarite occurs only in the wider filled cracks where it appears as a replacement of the fine-grained serpentine which fills all of the smaller openings. A sample ground to pass 100 mesh was treated with a heavy solution which did not result in materially improving the quality of the sample, although a few grains of serpentine and margarite were freed. It had previously been found, in preparing the hand-picked margarite sample for analysis, that this dark mineral was nearly nonmagnetic to the large research electromagnet.

The mineral making up the mass of the specimens is opaque in thin section and in finely ground powder under the microscope. A mass of average and typical material was selected for analysis, as free as possible from the larger seams of margarite. The method of analysis used gave fairly satisfactory results. The sample was pulverized and screened to pass two hundred mesh silk bolting

cloth, a portion of one half gram was weighed out and this was thoroughly ground into sodium carbonate containing a small amount of sodium nitrate. The sample with its intimately mixed flux was transferred to a covered 20 cc. platinum crucible and this was placed in a much larger covered crucible to preclude loss from boiling during the fusion. Fusion was continued at a full red heat for three hours. After cooling the melt was thoroughly leached with boiling water. The residue insoluble in water was washed on a filter and dissolved through the filter in dilute hydrochloric acid. No undecomposed residue of consequence remained. The water extract containing the chromium and aluminum with a part of the silica was acidified with hydrochloric acid and the silica separated by evaporation to dryness in the usual manner. The hydrochloric acid solution of alumina and chromium was again evaporated to dryness, moistened with strong hydrochloric acid and alcohol several times to reduce chromium, taken up in dilute acid and the chromium and aluminum precipitated with ammonia, ignited, and weighed together. The filtrate was found to be free from lime and magnesia.

The weighed alumina and chromic oxide were ground into sodium carbonate to which some nitrate had been added, fused and leached with water, leaving no residue. This solution was acidified with acetic acid, the chromium precipitated as barium chromate by addition of barium acetate, filtered on a gooch crucible and weighed. The alumina was taken by difference.

The hydrochloric acid solution containing the iron, lime, and magnesia was evaporated to dryness to separate silica and analyzed by standard methods. This was found to retain only traces of alumina and chromium. The silica was about equally divided between the two portions.

Since it was evident that the sample examined was not homogeneous in character but contained large numbers of fine cracks and seams filled with serpentine and margarite, it was concluded that the best that could be accomplished was to make a mass analysis of the ore and arrive at the composition of the chromite by deducting the impurities. In the following table, therefore, the analysis is given and it is then corrected for the presence of margarite, for which lime is taken as an index, the margarite having the composition previously determined by analysis. The balance of silica, after deducting margarite, is used to form serpentine.

ANALYSIS OF CHROME ORE FROM ETCHISON

	Analysis	Margarite	Serpentine	Chromite
SiO ₂	16.42%	3.11%	13.31%	—
Al ₂ O ₃	17.88	5.10		12.78
Cr ₂ O ₃	20.56	.07		20.49
FeO	17.62			17.62
CaO	1.08	1.08		
MgO	20.98	.27	12.98	7.73
H ₂ O	6.64	.50	3.89	
Total	101.18	10.13	30.18	58.62

The analysis, in the first place, indicates that the sample, containing as it does only 20.56 of chromic oxide, is a very poor ore of chromium. The interpretation of the analysis indicates 10.13 per cent of margarite, 30.18 per cent of serpentine and 58.62 per cent of a spinel mineral allied to chromite to have been present in the sample. The spinel contains, in addition to the constituents of chromite, important amounts of alumina and magnesia. Recalculated to 100 per cent, the corrected analysis gives results and ratios as follows:

FeO	30.06	.418	} .745
MgO	13.19	.327	
Al ₂ O ₃	21.18	.213	
Cr ₂ O ₃	34.95	.230	} .443
Total	100.00		

In the analysis the determination of the state of oxidation of the iron is precluded by the insoluble character of the mineral and this constituent is stated above as ferrous oxide. The ratios derived, however, do not approximate those of the spinel group in which the ratio of R''O to R'''₂O₃ should be 1:1. This indicates that the iron in the mineral exists both as ferrous and ferric oxide and, when the analysis is adjusted, on this assumption, the values obtained are as follow:

FeO	14.51%
MgO	13.19
Fe ₂ O ₃	16.13
Al ₂ O ₃	21.80
Cr ₂ O ₃	34.95
Total	100.58

This may be recalculated into standard molecules of the spinel group giving the following approximate results:

Chromite	FeO. Cr ₂ O ₃ .	48.80%
Magnesioferrite	MgO. Fe ₂ O ₃ .	20.20
Spinel	MgO. Al ₂ O ₃ .	30.36
		<hr/> 99.36

It seems probable that all of the chrome ore of this locality is of this nature and it is evident that the purest form of this spinel is entirely too low in chromic oxide to make a commercial chrome ore, even under the most favorable conditions likely to be encountered in the chrome ore market in this country.

PROCEEDINGS OF SOCIETIES

PHILADELPHIA MINERALOGICAL SOCIETY

Academy of Natural Sciences of Philadelphia, Sept. 10, 1925

A stated meeting of the Philadelphia Mineralogical Society was held on the above date, with an attendance of twenty-seven members. Vice-president Trudell presided.

The evening was devoted to reports of summer trips taken by various members of the society, the chair calling upon each one present to render an account of his summer activities.

Mr. Warford exhibited garnet from Chelsea, Delaware Co., Pa.

Mess^{rs}. Biernbaum and Hoadley exhibited large analcite crystals and brilliant prehnite from Paterson, N. J. This locality is again producing, but the quarry cannot be visited without a pass from the operators.

Mr. Hoadley reported trips to Haddam and Litchfield, Conn. He stated that the Tilly Foster Mine, N. Y., is unsafe to visit at the present time on account of the active hostility of its owner.

Dr. Cajori exhibited limonite pseudomorphs after pyrite from Dorset, Vt.

Mr. Trudell reported a trip taken over Labor Day by eight members of the Society to the French Creek Mines. Pyrite, urallite, and apophyllite were obtained. He also related his experiences on a recent trip to Europe, and described at length many noteworthy specimens in the British Museum at London.

HORACE R. BLANK, *Secretary*

Academy of Natural Sciences of Philadelphia, October 8, 1925

A stated meeting of the Philadelphia Mineralogical Society was held on the above date, with the vice-president, Mr. Trudell, in the chair. Twenty-six members and seven visitors were present.

The following officers were elected for the year 1925-26:

President:	George Vaux, Jr.
Vice President:	Harold W. Arndt.
Secretary:	Horace R. Blank.
Treasurer:	Henry E. Millson.
Councillor:	Morrell G. Biernbaum.

Mr. R. B. Gage exhibited a number of very fine specimens of topaz, rhodochrosite, hedyphane, carbonado diamond, roeblingite, planchéite and other minerals belonging to Colonel Washington A. Roebling of Trenton, N. J. Mr. Gage was requested to convey the thanks of the Society to Col. Roebling for the exhibit.

Mr. J. C. Boyle addressed the Society on "*Mineral Collecting in Ontario and Quebec*," describing a trip taken by four members to these regions in July 1925. The talk was illustrated by lantern slides and by a great number of excellent specimens. The latter included fluorite crystals from Madoc, Ont., cyrtolite, allanite, and ellsworthite from Hybla Ont., apatite crystals from Clear Lake, Renfrew Co., Ont., and large phlogopite and diopside crystals from the mica mines north of Hull, Quebec. On the return trip tourmaline was collected at Pierrepont, N. Y., and danburite at South Russell, N. Y. The entire trip was taken by auto, and covered about 1400 miles.

HORACE R. BLANK, *Secretary*

NOTES AND NEWS

NOTE ON THE DECOLORIZATION OF METHYLENE IODIDE. O. IVAN LEE, *Jersey City, N. J.* Like most alkyl halogens, methylene iodide is subject to incipient decomposition (reduction) as a result of traces of residual iodoform, exposure to light and contact with organic matter (dust, cork), and the iodine so released speedily darkens the solution so that for all practical purposes it is objectionably opaque. The literature states that this color may be removed by the addition of copper, but copper shot left in discolored methylene iodide for many months failed to have any visible effect, perhaps because of a protective film of cuprous oxide or the formation of one of cuprous iodide. It was suggested that mercury because of its well known affinity for iodine as well as by reason of its motility might be more effective. A very dark sample of methylene iodide was therefore violently shaken with a drop of mercury for several minutes. The color progressively lightened finally becoming a clear (greenish) yellow. Most of the mercury with adherent mercury iodide remained at the bottom, but a small amount remained suspended for some time. This, however, may readily be removed at once by filtering. Another drop of mercury added to the filtrate inhibits any further decomposition indefinitely, and the color finally becomes pale yellow. This clear light colored methylene iodide will be found much more serviceable for use in density determinations.

A Bibliography of Bibliographies on Chemistry and Chemical Technology, 1900-1924, by Clarence J. West and D. D. Berolzheimer, is announced by the National Research Council, Washington, D. C., as their Bulletin No. 50 (308 p., \$2.50). The work is a compilation of bibliographies published as separates, or at the end of books or magazine articles, or as footnotes, on the numerous aspects of

pure and applied chemistry. An approximate analysis shows that there are about 2400 subject headings, 7500 author entries and a total of 10,000 individual bibliographies.

The National Research Council has contracted to publish the "International Critical Tables of Numerical Data of Physics, Chemistry and Technology" in five volumes. In the contract the National Research Council has reserved to individuals who are members of scientific and engineering societies the right to purchase the volumes at manufacturing cost, \$35.00, provided applications are filed with the National Research Council, B and Twenty-first Streets, Washington, D. C., prior to the publication of the first volume which is scheduled to appear early in 1926. The price after publication of the first volume will be \$60.00 for the complete set.

Edward S. Law, geologist and mineralogist of Charlemont, Massachusetts, has been engaged for some time by a New York mining engineer in the re-location of some of the old-time prospects for copper, iron, manganese, lead and barium, as a result of which he has obtained some unusually fine material from many of the remote corners of the Berkshire region and elsewhere.

More than four thousand specimens of the minerals of the rarer metals collected by Frank L. Hess during eighteen years' service with the U. S. Geological Survey, have been turned over to the U. S. National Museum.

According to *Science News* a new source of helium has been suggested by Dr. Kurt Peters of the Physical-Technical Institute of Berlin. It can be distilled from radio-active minerals used in the various industries, especially from monazite sand. Dr. Peters claims that this source, which is the most important in Germany, can produce from fifteen to twenty thousand cubic feet annually.

J. Samoiloff, professor of mineralogy at the Academy of Agriculture, Moscow, died suddenly on September 29 in his fifty-fifth year. Professor Samoiloff was especially interested in the problems of the sedimentary rocks and had carried on extensive investigations on the phosphate deposits of Russia.

According to a bulletin from the Russian Academy of Sciences, a new discovery of high grade uraninite ore has been reported from the western coast of the White Sea. Samples brought to Leningrad have been analyzed by the Radium Institute which reports the ore as rich in uranium as that obtained in Joachimsthal. The Academy has sent an expedition led by A. E. Fersman to the White Sea district in order to secure large quantities of the ore.

A leaflet received from the Mineral-Exchange Bureau of the Institute of Economic Mineralogy and Metallurgy (Hospital Street 8, Leningrad, Russia) calls attention to a number of minerals, including some of the rarer types, which may be purchased at reasonable prices. The minerals listed include those from the Kola peninsula, Fergana, Ilmen Mountains, Zlatoust district, and from Central and Eastern Siberia.